

### **REMARKS**

Claims 1-6 are pending and under consideration in this application. Reconsideration is requested based on the following remarks.

#### **Response to Arguments:**

The Applicants appreciate the consideration given to their arguments. The Applicants, however, are disappointed that their arguments were not found to be persuasive. The Office Action asserts in the last full paragraph at page 6, that:

Applicant argues that Inagawa does not teach "form a via hole with an underlying layer exposed at its bottom". The examiner respectfully notes that applicant's claim does not state this, but rather the first step forms a via hole and the second step removes the modified layer of resin remaining at the bottom of the hole and form a via hole with an underlying layer exposed at its bottom.

Since, as noted in the Office Action in line 7 of the section entitled "Response to Arguments," the "second step removes the modified layer of resin remaining at the bottom of the hole and form a via hole with an underlying layer exposed at its bottom," claim 1, for example, does recite "form a via hole with an underlying layer exposed at its bottom."

The Office Action goes on to assert in the last full paragraph at page 6, that:

Inagawa et al. specifically teaches the first laser forming a via in which a carbide black (modified layer) is formed in the via.

This is submitted to be incorrect. The carbide generated by the CO<sub>2</sub> laser beam 4a is not a modified layer, contrary to the assertion in the Office Action, let alone "a modified layer of the resin remaining at the bottom of said hole," as recited in, for example, claim 1. The carbide generated by the CO<sub>2</sub> laser beam, rather, is attached to the *surface* of the through hole, not "the bottom of said hole" as recited in, for example, claim 1. In particular, as described at column 3, lines 60-68:

As long wavelength laser is used a CO<sub>2</sub> laser with a wavelength of 10.6 microns. In the first step, a first through hole is formed as shown in FIG. 2(b). As shown schematically in the sectional view of FIG. 2(b), the through hole has an irregular wall surface consisting of raised portions presumably constituted by residue of glass part and depressed portions formed by removal of epoxy. Further, carbide particles are attached to the surface as shown by dots.

The Office Action goes on to assert in the last full paragraph at page 6, that:

The second laser removes the carbide.

Since, as discussed above, the carbide is attached to the *surface* of the hole, the carbide removed by the second laser of Inagawa is not "at the bottom of said hole," let alone "a modified layer of the resin remaining at the bottom of said hole," as recited in, for example, claim 1.

The Office Action goes on to assert in the last full paragraph at page 6, that:

A third step may be used to remove the underlying layer exposed at its bottom (i.e. step d). Figures 4 & 8 demonstrate the process:

This is submitted to be incorrect. The sole excimer laser beam 2a is employed in the third step of Inagawa to *process* the copper foil part of the printed circuit board, not remove "a modified layer of the resin remaining at the bottom of said hole" as recited in, for example, claim 1. In particular, as described at column 6, lines 7, 8, and 9:

During processing of copper foil part as shown in FIG. 4(c), sole excimer laser beam 2a is employed as shown in FIG. 5(c).

Since the sole excimer laser beam 2a is employed in the third step of Inagawa to process the copper foil part of the printed circuit board, Inagawa does not "remove a modified layer of the resin remaining at the bottom of said hole," as recited in, for example, claim 1.

A last irradiation with excimer laser beam 2a, finally, is effected as a finish step of removing residual material from the hole wall *surface* after the through hole is *formed*, as shown in FIG. 4(d). In particular, as described at column 6, lines 10-13:

After the through hole is formed as shown in FIG. 4(d), last irradiation with excimer laser beam 2a is effected as a finish step of removing residual material from the hole wall surface.

Since the last irradiation with excimer laser beam 2a is effected as a finish step of removing residual material from the hole wall surface, Inagawa does not "remove a modified layer of the resin remaining at the bottom of said hole," as recited in, for example, claim 1. Further reconsideration is thus requested.

#### **Claim Rejections - 35 U.S.C. § 103:**

Claims 1 and 3 were rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 5,166,493 to Inagawa et al. (hereinafter "Inagawa") in view of U.S. Patent No. 6,280,641 to Gaku et al. (hereinafter "Gaku '641") and the section of the subject application entitled

Background Art (hereinafter "Background Art"), to which the Office Action refers as AAPA. The rejection is traversed. Reconsideration is earnestly solicited.

The claimed invention uses laser beams of different wavelengths selectively with respect to an inorganic filler or a modified layer of resin. The claimed invention thus forms a via hole successfully with a bottom free from residue. The second clause of claim 1, in particular, recites:

Firing onto the resin layer including the inorganic filler a laser beam of a wavelength within the infrared region and not absorbed by the inorganic filler, at a position of said resin layer for forming a via hole so as to expel the resin and said inorganic filler and thereby form a hole in said resin layer.

Neither Inagawa, Gaku '641, nor the Background Art teaches, discloses, or suggests "firing onto the resin layer including the inorganic filler a laser beam of a wavelength within the infrared region and not absorbed by the inorganic filler, at a position of said resin layer for forming a via hole so as to expel the resin and said inorganic filler and thereby form a hole in said resin layer," as recited in claim 1. Inagawa, in contrast, forms an opening with two laser beams, and is quite silent about the selective use of laser beams of different wavelengths to expel and remove an inorganic filler. Inagawa, in other words, describes nothing about a relationship between a wavelength of the laser beam and an inorganic filler.

Inagawa, moreover, is quite silent about the use of a laser beam of a specific wavelength for removing resin remaining after expelling the inorganic filler. Nor does Inagawa describe a relationship between a wavelength of a laser beam and a modified layer or resin remaining at the bottom of the hole.

Neither Gaku '641 nor the Background Art are "firing onto the resin layer including the inorganic filler a laser beam of a wavelength within the infrared region and not absorbed by the inorganic filler, at a position of said resin layer for forming a via hole so as to expel the resin and said inorganic filler and thereby form a hole in said resin layer" either, and thus cannot make up for the deficiencies of Inagawa with respect to claim 1.

The Office Action acknowledges in the first full paragraph at page 3 that Inagawa "does not specifically teaches inorganic filler," and attempts to compensate for this deficiency of Inagawa by combining Inagawa with US Patent Application Publication No. 2003/00783332 Kawaguchi et al. The Office Action, however, provides no motivation or suggestion to combine the teachings of Inagawa and Kawaguchi, as required by 35 U.S.C. § 103(a) and the M.P.E.P. §706.02(j)(D), beyond the assertion that:

It is known in the art that glass in a printed wire board is classified as an inorganic filler; see Kawaguchi et al. (USPAP 2003/0078333). Thus Inagawa et al. inherently teaches an inorganic filler (glass).

There is no place for the concept of inherency in a rejection under 35 U.S.C. § 103(a). Even if there were, however, an inorganic filler is not inherent, since Inagawa, for example, could have just as easily done what he did, and avoided using an inorganic filler in the first place.

Inagawa is complete in itself. It is submitted, therefore, that persons of ordinary skill in the art at the time the invention was made would not have modified Inagawa as proposed in the Office Action, since it would have served no purpose.

The third clause of claim 1 recites:

Firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom.

Neither Inagawa, Gaku '641, nor the Background Art teaches, discloses, or suggests "firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom," as recited in claim 1. Inagawa, rather, uses a short wavelength laser for smoothing the bore wall. In particular, as described in the Abstract:

A first step of the process is high speed rough boring by thermal processing using a long wavelength laser, and a second step is an optical chemical processing using a short wavelength laser for smoothing the bore wall.

Since Inagawa uses a short wavelength laser for smoothing the bore wall, Inagawa is not "firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom," as recited in claim 1.

Inagawa, in fact, is forming a *through* hole, not a hole with "a modified layer of the resin remaining at the bottom of said hole" as recited in claim 1. In particular, as described further in the Abstract:

A highly reliable through hole can be high speed processed in a short period of

time.

Since Inagawa is forming a through hole, Inagawa is not "firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom," as recited in claim 1.

Inagawa, moreover, is smoothing the *wall* of a *through* hole by opto-chemical processing using a short wavelength laser, not removing "a modified layer of the resin remaining at the bottom of said hole," as recited in claim 1. In particular, as described at column 2, lines 20-28:

To attain the above first object of the invention, there is provided an apparatus, which can perform a two-step process consisting of a first step of high speed forming a hole by thermal processing using a long wavelength laser and a second step of smoothing the hole wall by opto-chemical processing using a short wavelength laser, thus obtaining a highly reliable through hole having a small diameter and excellent hole wall shape in a short period of time.

Since Inagawa is smoothing the hole wall by opto-chemical processing using a short wavelength laser, Inagawa is not "firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom," as recited in claim 1.

Inagawa, moreover, is finishing of the hole *wall* surface to a smooth surface with less irregularities, not removing "a modified layer of the resin remaining at the bottom of said hole," as recited in claim 1. In particular, as described at column 2, lines 36-46:

A second object of the invention is to provide an apparatus, which provides a pulse laser beam output of a short wavelength laser such as an excimer laser for a copper foil circuit pattern part, provides a pulse laser beam output of a long wavelength laser such as a CO<sub>2</sub> laser for a resin part, and further provides alternate pulse laser beam outputs of short and long wavelength lasers for removal of carbide generated in the processing of the resin part, thus permitting finishing of the hole wall surface to a smooth surface with less irregularities.

Since Inagawa is finishing of the hole wall surface to a smooth surface with less irregularities, Inagawa is not "firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom," as recited in claim 1.

In Inagawa, moreover, the *surface* of the first *through* hole is irradiated with the short wavelength laser beam 4, not “the bottom of said hole,” as recited in claim 1. In particular, as described at column 4, lines 1-4:

In a second step, as shown in FIG. 2(c) the surface of first through hole formed in the first step is irradiated with short wavelength laser beam 4 from short wavelength laser beam generator means (not shown).

Since, in Inagawa, the surface of the first through hole formed in the first step is irradiated with the short wavelength laser beam 4, Inagawa is not “firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom,” as recited in claim 1.

Finally, in Inagawa, the last irradiation with excimer laser beam 2a is effected as a finish step of removing residual material from the hole wall surface *after* the through hole is formed. There *is* no “bottom of said hole,” as recited in claim 1, *after* the through hole is formed. In particular, as described at column 6, lines 10-13:

After the through hole is formed as shown in FIG. 4(d), last irradiation with excimer laser beam 2a is effected as a finish step of removing residual material from the hole wall surface.

Since, in Inagawa, the last irradiation with excimer laser beam 2a is effected as a finish step of removing residual material from the hole wall surface after the through hole is formed, Inagawa is not “firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom,” as recited in claim 1.

Neither Gaku '641 nor the Background Art are “firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom” either, and thus cannot make up for the deficiencies of Inagawa with respect to claim 1. Claim 1 is submitted to be allowable. Withdrawal of the rejection of claim 1 is earnestly solicited.

Claim 3 depends from claim 1 and add further distinguishing elements. Claim 3 is thus submitted to be allowable as well. Withdrawal of the rejection of claim 3 is earnestly solicited.

Claims 2 and 6:

Claims 2 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Inagawa, Gaku '641, and the Background Art in view of U.S. Patent Application Publication No. 2003/0049913 to Gaku et al. (hereinafter "Gaku '913"). The rejection is traversed. Reconsideration is earnestly solicited.

Claim 2 depends from claim 1 and adds further distinguishing elements. Neither Inagawa, Gaku '641, nor the Background Art teaches, discloses, or suggests "firing onto the resin layer including the inorganic filler a laser beam of a wavelength within the infrared region and not absorbed by the inorganic filler, at a position of said resin layer for forming a via hole so as to expel the resin and said inorganic filler and thereby form a hole in said resin layer," or "firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom," as discussed above with respect to the rejection of claim 1. Gaku '913 does not either, and thus cannot make up for the deficiencies of either Inagawa, Gaku '641, or the Background Art with respect to claim 2. Gaku '913, rather, only describes a type of laser beam and is quite silent about a relationship between a wavelength of the laser beam and the inorganic filler or the modified layer. Thus, even if Inagawa, Gaku '641, the Background Art, and Gaku '913 were combined as proposed in the Office Action, claim 2 would not result. Claim 2 is thus submitted to be allowable. Withdrawal of the rejection of claim 2 is earnestly solicited.

Claim 6:

The second clause of claim 6 recites:

Providing an infrared laser beam not absorbed by the inorganic filler.

Neither Inagawa, Gaku '641, nor the Background Art teaches, discloses, or suggests "providing an infrared laser beam not absorbed by the inorganic filler," as discussed above with respect to the rejection of claim 1. Gaku '913 does not either, and thus cannot make up for the deficiencies of either Inagawa, Gaku '641, or the Background Art with respect to claim 6.

The seventh clause of claim 6 recites:

Providing an ultraviolet laser beam capable of cleaving C-C bonds of the resin.

Neither Inagawa, Gaku '641, nor the Background Art teaches, discloses, or suggests

"providing an ultraviolet laser beam capable of cleaving C-C bonds of the resin," as discussed above with respect to the rejection of claim 1. Gaku '913 does not either, and thus cannot make up for the deficiencies of either Inagawa, Gaku '641, or the Background Art with respect to claim 6.

The tenth clause of claim 6 recites:

Exposing an underlying layer at the bottom of the via hole by removing the modified layer of the resin.

Neither Inagawa, Gaku '641, nor the Background Art teaches, discloses, or suggests "exposing an underlying layer at the bottom of the via hole by removing the modified layer of the resin," as discussed above with respect to the rejection of claim 1. Gaku '913 does not either, and thus cannot make up for the deficiencies of either Inagawa, Gaku '641, or the Background Art with respect to claim 6. Thus, even if Inagawa, Gaku '641, the Background Art, and Gaku '913 were combined as proposed in the Office Action, claim 6 would not result. Claim 6 is thus submitted to be allowable. Withdrawal of the rejection of claim 6 is earnestly solicited.

Claim 4:

Claim 4 was rejected under 45 U.S.C. § 103(a) as being unpatentable over Inagawa, Gaku '641, and the Background Art in view of U.S. Patent No. 6,413,820 to Bui (hereinafter "Bui") or U.S. Patent No. 6,226,173 to Welsch et al. (hereinafter "Welsch"). The rejection is traversed. Reconsideration is earnestly solicited.

Claim 4 depends from claim 1 and adds further distinguishing elements. Neither Inagawa, Gaku '641, nor the Background Art teaches, discloses, or suggests "firing onto the resin layer including the inorganic filler a laser beam of a wavelength within the infrared region and not absorbed by the inorganic filler, at a position of said resin layer for forming a via hole so as to expel the resin and said inorganic filler and thereby form a hole in said resin layer," or "firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom," as discussed above with respect to the rejection of claim 3. Neither Bui nor Welsch do either, and thus cannot make up for the deficiencies of either Inagawa, Gaku '641, or the Background Art with respect to claim 4. Thus, even if Inagawa, Gaku '641, the Background Art, and Bui or Welsch were combined as proposed in the Office Action, claim 4



would not result. Claim 4 is thus submitted to be allowable. Withdrawal of the rejection of claim 4 is earnestly solicited.

**Claim 5:**

Claim 5 was rejected under 55 U.S.C. § 103(a) as being unpatentable over Inagawa, Gaku '641, and the Background Art in view of U.S. Patent No. 6,649,824 to Den et al. (hereinafter "Den") or U.S. Patent No. 6,226,173 to Yaita et al. (hereinafter "Yaita"). The rejection is traversed to the extent it might apply to the claims as amended. Reconsideration is earnestly solicited.

Claim 5 depends from claim 1 and adds further distinguishing elements. Neither Inagawa, Gaku '641, nor the Background Art teaches, discloses, or suggests "firing onto the resin layer including the inorganic filler a laser beam of a wavelength within the infrared region and not absorbed by the inorganic filler, at a position of said resin layer for forming a via hole so as to expel the resin and said inorganic filler and thereby form a hole in said resin layer," or "firing a laser beam of a wavelength within the ultraviolet region and capable of cleaving C-C bonds of the resin, focused at a position where said hole is formed to remove a modified layer of the resin remaining at the bottom of said hole and form a via hole with an underlying layer exposed at its bottom," as discussed above with respect to the rejection of claim 3. Neither Den nor Yaita do either, and thus cannot make up for the deficiencies of either Inagawa, Gaku '641, or the Background Art with respect to claim 5. Thus, even if Inagawa, Gaku '641, the Background Art, and Den or Yaita were combined as proposed in the Office Action, claim 5 would not result. Claim 5 is thus submitted to be allowable. Withdrawal of the rejection of claim 5 is earnestly solicited.

**Conclusion:**

Accordingly, in view of the reasons given above, it is submitted that all of claims 1-6 are allowable over the cited references. Allowance of all claims 1-6 and of this entire application is therefore respectfully requested.

Finally, if there are any formal matters remaining after this response, the Examiner is invited to telephone the undersigned to attend to these matters.

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If there are any additional fees associated with filing of this Amendment, please charge them to our Deposit Account No. 19-3935.

Respectfully submitted,

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